A

Workshop-cum-Short Term Training Program

on

Nonlinear Dynamics and Bifurcations in Classical Solids

by

PROF. KARAN S. SURANA, UNIVERSITY OF KANSAS, USA

under

Fulbright Specialist Program (FSP)

(24th May - 3rd June 2025)

Organized By:

Department of Mechanical Engineering

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

J L N Marg, Malviya Nagar, Jaipur, Rajasthan -302017

Website: www.mnit.ac.in

About Fulbright Specialist Program (FSP)	The Fulbright Specialist Program (FSP) is a part of the larger Fulbright Program sponsored by the U.S. Department of State and administrated by World Learning. It provides opportunities for institutions around the world to host a highly experienced American academic or professional to exchange knowledge, build host institution capacity, and promote long-lasting international collaboration. The program is a field-driven initiative in which foreign host institutions conceptualize and design a short-term project that addresses a specific need or priority at their respective organization. Host institution projects are then matched with a U.S. Specialist, who shares their expertise and assists with strengthening linkages between U.S. and foreign institutions.
About MNIT Jaipur	Malaviya National Institute of Technology (MNIT) Jaipur, established in 1963 as Malaviya Regional Engineering College (MREC), was later recognized as a National Institute of Technology (NIT) in 2002 and designated as an Institute of National Importance by the Government of India. Spread across 317 acres, the institute boasts modern infrastructure, including smart classrooms, advanced laboratories, research centers, a central library, computing resources, residential quarters, and sports complexes. Offering undergraduate, postgraduate, and doctoral programs across disciplines such as Engineering, Science, Management, and Humanities, MNIT Jaipur is a hub for cutting-edge research in renewable energy, artificial intelligence, nanotechnology, and structural engineering, collaborating with institutions like IITs, ISRO, DRDO, and international universities. The institute is home to Centers of Excellence in Renewable Energy, Materials Science, and Cyber-Physical Systems, actively promotes startups and innovation through its Technology Business Incubator (TBI), and frequently hosts national and international conferences, workshops, and training programs. With its strong emphasis on academic excellence, research, and industry collaborations, MNIT Jaipur continues to be a leading institution shaping future innovators and technologists.
Overview of this course	The mathematical models for linear (infinitesimal deformation) and nonlinear (finite deformation and finite strain) dynamics of continuous solid media—such as beams, plates, and shells—are based on kinematic assumptions. However, the mathematical models currently in use are not supported by the Conservation and Balance Laws (CBL) of Classical Continuum Mechanics (CCM) or Non-Classical Continuum Mechanics (NCCM), making them inconsistent with thermodynamic equilibrium. While these models perform satisfactorily for simple deformation physics (such as linear elasticity), their extension to finite deformation physics, dissipation, and memory mechanisms is not possible in R_2 and R_3, as the CBL of CCM cannot be employed for such cases. Several papers by Surana et al. have highlighted and illustrated these deficiencies in the currently used mathematical models for solid continua. This proposal aims to derive new mathematical models for solid continua in R_1, R_2, and R_3, strictly based on the CBL of CCM, for thermoelastic and thermoviscoelastic solid continua (with and without memory) under finite deformation and finite strain conditions. This approach will eliminate kinematic assumptions, ensuring that the mathematical description of deformation physics adheres strictly to thermodynamic principles. The second aspect of this work will establish a unified finite element computational infrastructure for solving Boundary Value Problems (BVPs) and Initial Value Problems (IVPs). This will involve both space-time coupled and space-time uncoupled methodologies, ensuring that the integral forms remain variationally consistent, thus guaranteeing unconditional computational stability. By using higher-order scalar product spaces (hpk), this work will ensure that the physics of BVPs and IVPs is correctly represented in the computational process.

Objectives of the course	The objectives of this course are as follows: • Gain full competency in the understanding and use of mathematical models for linear and nonlinear dynamics of continuous media based on the principle of thermodynamics that addresses the deformation physics of thermo-elastic and thermo-viscoelastic matter with and without memory. • Gain depth and working knowledge of finite element computational infrastructure for obtaining the solutions of the PDEs in BVPs and IVP described by the mathematical models. • Develop know-how regarding the potential application of these developments in addressing actual industrial problems that are currently difficult (or not possible) to simulate with present mathematical models and computational approaches with reasonable accuracy.
Key topics to be covered	✔ Mathematical Models for Solid Continua ✔ Conservation and Balance Laws in Continuum Mechanics ✔ Finite Element Computational Infrastructure for BVPs & IVPs ✔ Linear and Nonlinear Dynamics of Continuous Media ✔ Static & Dynamic Bifurcations ✔ Applications to Real-World Engineering Problems
Who should attend the course	📌 Faculty, Researchers and Industry Persons – Enhance knowledge in computational mechanics & nonlinear dynamics. 📌 Graduate, Postgraduate & Ph.D. Students – Gain insights into cutting-edge research methodologies.
Course Fees	There is **no participation fee** for this course. But the participants have to bear their own cost of food and accommodation.
Registration	Participants are required to send a scanned copy of the duly fill registration form (given at the end this brochure) through email: **dkumar.mech@mnit.ac.in** by ***15th May, 2025.***
Accommodation	Limited accommodation in the Institute Hostels/Guest Houses may be arranged on payment basis on prior request, subject to the availability OR otherwise participants will have to make their own stay and food arrangements.
About Jaipur	Jaipur, the capital of Rajasthan, is famously known as the Pink City due to the distinct pink-colored sandstone used in its historic walled city. It was the stronghold of a clan of Rajput rulers, whose forts and palaces remain prime tourist attractions today. Jaipur is renowned for its vibrant markets, selling: Embroidered leather shoes, Blue pottery, Tie-and-dye scarves, Traditional handicrafts. The city is a gateway to Western Rajasthan, a region shaped by the Thar Desert, offering rich history, unique architecture, and cultural heritage. Weather in Jaipur experiences hot summer temperatures during May, with daytime highs ranging between 38–45°C (100–113°F) and nighttime temperatures around 25–30°C (77–86°F). It is advised to wear light cotton clothes, stay hydrated, and use sun protection while outdoors. Most prominent tourist places to visit in Jaipur are Hawa Mahal, Jantar Mantar, City Palace, Albert Hall Museum, Amber Fort- Heritage Palace, Nahargarh fort, Jaigarh fort, Jal Mahal, Kanak Varindavan garden, Govind Dev Ji temple.
How to Reach MNIT Jaipur	Jaipur is well connected by Air, Road and Rail with all the major cities and railway stations in India. It is about 280 Kms from New Delhi. It has direct flights from New Delhi (45 min), Mumbai (1.5 hrs) and Kolkata (2.2 hrs). The Institute is prominently located on JLN Marg and is 15 minutes from the Airport. It is 10 Kms from the main Railway Station and Bus Stand. You can easily hire taxis/autos (OLA, UBER, and other local service providers) in Jaipur around the clock.

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<td>Course Expert:
 
Prof. Karan S. Surana</td>
<td>Karan S. Surana, born in India, went to undergraduate school at BITS, Pilani, India, and received a B.E. degree in Mechanical Engineering in 1965. He then attended the University of Wisconsin, Madison, where he obtained M.S. and Ph.D. degrees in Mechanical Engineering in 1967 and 1970, respectively. He worked in industry, in research and development in various areas of computational mechanics and software development, for fifteen years: SDRC, Cincinnati (1970–1973), EMRC, Detroit (1973–1978); and McDonnell-Douglas, St. Louis (1978–1984). In 1984, he joined the Department of Mechanical Engineering faculty at the University of Kansas, where he is currently the Deane E. Ackers University Distinguished Professor of Mechanical Engineering. His areas of interest and expertise are computational mathematics, computational mechanics, and continuum mechanics. He is the author of over 350 research reports, conference papers, and journal articles. He has served as advisor and chairman of 50 M.S. students and 25 Ph.D. students in various areas of Computational Mathematics and Continuum Mechanics. He has delivered many plenary and keynote lectures in various national and international conferences and congresses on computational mathematics, computational mechanics, and continuum mechanics.
He has served on international advisory committees of many conferences and has co-organized mini-symposia on k-version of the finite element method, computational methods, and constitutive theories at U.S. National Congresses of Computational Mechanics organized by the U.S. Association of Computational Mechanics (USACM). He has organized mini-symposium on classical and non-classical continuum mechanics at SES (Society of Engineering Science). He is a member of the International Association of Computational Mechanics (IACM) USACM, SES, and a fellow and life member of ASME.
Dr. Surana’s most notable contributions include: large deformation finite element formulations of shells, the k-version of the finite element method, operator classification and variationally consistent integral forms in methods of approximations for BVPs and IVPs, and ordered rate constitutive theories for solid and fluent continua. His most recent and present research work is in non-classical continuum theories for solid and fluent continua and associated constitutive theories. He is the author of recently published textbooks: Advanced Mechanics of Continua, CRC/Taylor & France, The Finite Element Method for Boundary Value Problems: Mathematics and Computations, CRC/Taylor & Francis, The Finite Element Method for Initial Value Problems: Mathematics and Computations, CRC/Taylor & Francis, and Numerical Methods and Methods of Approximation in Science and Engineering, CRC/Taylor & Francis. You may reach him at: kssurana@ku.edu.</td>
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<td>Course Coordinators:</td>
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(24th May - 3rd June 2025)

Day-wise Course Schedule

Date	Time Slot	Topic
May 24, 2025 (Saturday)	9:30 AM - 10:30 AM	Mathematical models for beams based on kinematic assumptions
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	
May 25, 2025 (Sunday)	9:30 AM - 10:30 AM	Mathematical models for plates and shells based on kinematic assumptions
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	Workshop, tutorials
May 26, 2025 (Monday)	9:30 AM - 10:30 AM	Conservation balance laws of classical continuum mechanics for solid continua
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	
May 27, 2025 (Tuesday)	9:30 AM - 10:30 AM	Constitutive theories for solid continua
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	
May 28, 2025 (Wednesday)	9:30 AM - 10:30 AM	Methods of solution for BVPs
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	
May 29, 2025 (Thursday)	9:30 AM - 10:30 AM	Methods of solution for BVPs
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	Workshop, tutorials
May 30, 2025 (Friday)	9:30 AM - 10:30 AM	Methods of solution for IVPs
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	
May 31, 2025 (Saturday)	9:30 AM - 10:30 AM	Methods of solution for IVPs
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	Workshop, tutorials
June 2, 2025 (Monday)	9:30 AM - 10:30 AM	Linear and nonlinear dynamics
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	
June 3, 2025 (Tuesday)	9:30 AM - 10:30 AM	Static and dynamic bifurcations
	11:00 AM - 12:30 PM	
	2:30 PM - 4:00 PM	

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Registration form*

Name (In Block Letters): .....

Registration Category (Tick as applicable):

☐ UG/PG Student
☐ Ph.D. Scholar
☐ Faculty Member
☐ Industry Professional
☐ Other (Specify) _____

Qualification: .....

Institution/ Organization: .....

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Address: .....

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Email ID.: .....

Mobile No: .....

Declaration

I hereby declare that the information provided above is true to the best of my knowledge. I agree to abide by the rules and regulations of the workshop.

Signature of Participant: _____
Date: _____

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* Kindly mail the scanned copy of the duly filled registration form to: dkumar.mech@mnit.ac.in.